Gazelle
Mobile Eye-tracking for Sports

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ABSTRACT

In collaboration with the Institute of Sport Science (IPSW) at the University of Bern, the microLab research group at the HuCE institute develops an outdoor eye-tracking system with scene overlay. Due to its field of application, system miniaturization and processing speed are the key elements of this project.

SYSTEM & FACTS

The main features of the Gazelle system include:

- High mobility for the use in practical sport settings
- Calibration-free setup due to 3D eye modeling.
- High frame rate for scene and eye video

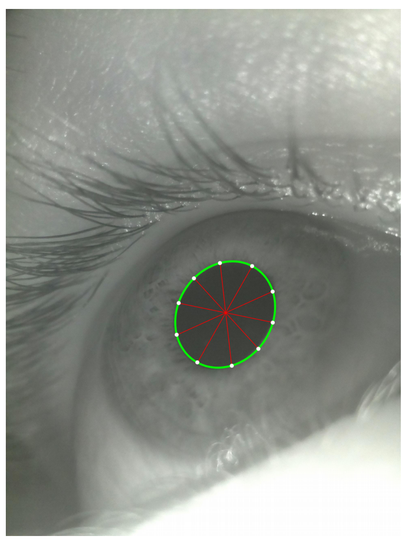

Figure 1: Starburst algorithm for pupil tracking

EYE MOVEMENTS IN SPORTS

Currently, mobile eye-tracking systems are used in quasi-static environments, for example in studies for product marketing in the supermarkets. Moreover current eye tracking systems restrict the field of view and have a poor wearing comfort. Those facts make eye-trackers hardly usable in outdoor sport environments.

The team at the ISPW Bern has several years of experience in researching the impact of gaze behavior on decision-making in sports situations. The eye-tracking systems used therein are mobile, but are primarily designed for lab use.

REQUIREMENTS FOR A NEW SYSTEM

To be able to compare the results obtained in lab conditions to real sports situations, the cooperation project aims to develop a highly mobile eye-tracker suitable for outdoor competitive sports.

Light weight as well as compactness in addition to lower risk of injury are the core requirements to the new eye-tracking system. In addition, the athlete wearing the device should in no way be influenced by the eye-tracking system.

Figure 2: A mountain biker wearing a state-of-the-art third party eye-tracker which is not appropriate for sports

OUR CONCEPT

Eye tracking systems analyze the pupil movements and combine them with a scene image to visualize the wearer's gaze path. The challenge in optical systems is finding the best possible camera angle with respect to the eye, without limiting the field of view. Our concept is based on safety glasses for sports, in which we integrate miniature cameras. These cameras allow a direct view on the eyes from inside of the glasses. In addition, the ambient light at visible spectrum is canceled out resulting in a increased gaze tracking stability and thus better system robustness under challenging light conditions.

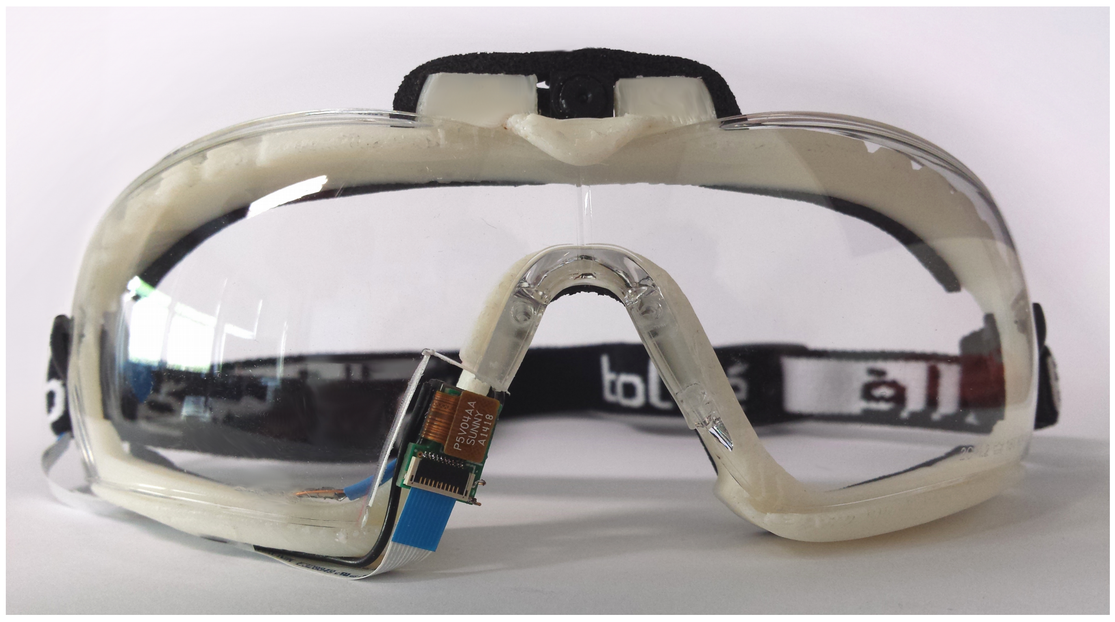

Figure 3: Our current Gazelle glasses prototype. The miniature cameras are fully integrated in the frame.

In particularly dynamic situations it can come to shifts of the eye tracking glasses. Usually this requires a re-calibration of the system. Our solution with two cameras per eye and the corresponding signal processing algorithms can create a 3D model of the eyeball and thus detect displacements of the system and compensate them in real time. In addition, the modeling allows an autonomous calibration, which means a significant increase in operator convenience compared to existing eye-tracking systems.

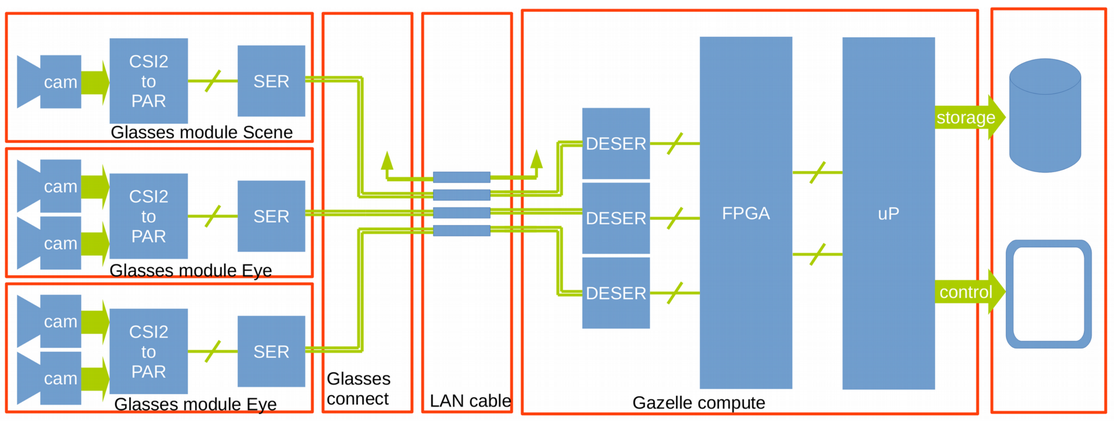

Figure 4: The new Gazelle system concept

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